

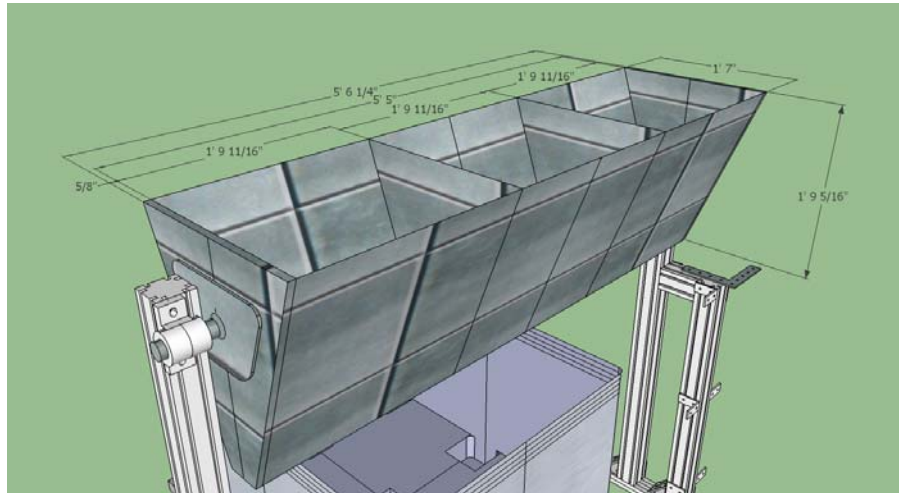
Lunabotics Mining Competition FAQ (new or revised Q&As in red)

Sandbox Questions

- Q. At the 2009 Regolith Excavation Challenge, some of the competitors kicked up a LOT of simulant (enough that visibility more than a meter was almost impossible). Given that two teams are competing at the same time, will there be any measures in place to make sure teams won't be at a disadvantage?**
- A. Regarding the dust mitigation, the Lunabotics Mining Competition sandbox is much larger than the 2009 Centennial Challenge sandbox and the two robots will be on separate sides of the box. However, the possibility of dust is a challenge which you need to design around and overcome.
- Q. Can we use LED lights on the lunabot for situational awareness to mitigate the dust?**
- A. It is up to the teams to decide if they want to have their own cameras mounted on the robot or use the situational awareness cameras provided. LED lights were used at the 2009 Regolith Excavation Centennial Challenge for situational awareness. We will have a camera at each end of the sandbox: one looking towards the mining area and one looking towards the collector box.
- Q. Can we set up our own cameras in the room (not on the robot) in order to monitor the robot?**
- A. No, only NASA house cameras may be used for off board camera situational awareness.
- Q. How many camera views are in the sandbox? Will the monitor view given be in color or black and white?**
- A. The monitors in the control room will be color. The actual placement and angle of the cameras in the corners of the tent looking down on the sandbox will not be known until we set it up the week before the competition.
- Q. Last year we were pretty surprised that a lot of the teams had no on board camera for their robot and simply used the Lunarena camera. We had been under the impression that this wouldn't be allowed. Will this be the same this year?**
- A. NASA will provide cameras in the Lunarena again for situational awareness only. An onboard camera may give you an advantage, however, there is no rule requiring an onboard camera on your Lunabot. If you do have an onboard camera, it does count toward your mass limit.
- Q. How full will the sandbox be? If the depth of the box is 1 meter, is it safe to assume the regolith will be about a meter deep?**
- A. The BP-1 aggregate will be less than one meter in depth. The sandbox itself is 1 meter high and we will have enough of a border to safely contain the excavators. The collector bin will be approximately 1 meter in height from the surface of the BP-1 aggregate.
- Q. Will the regolith get thicker/more compressed with depth?**
- A. The density of the compacted BP-1 aggregate will be between 1.5 g/cm³ and 1.8 g/cm³. The top 2 cm will be raked to a fluffy condition of approximately .75 g/cm³. There are naturally occurring rocks in the BP-1 aggregate.

Q. I wanted the layout with dimension of the collection bin in the Lunarena. I would like the dimensions on a top view and side view. Is it fixed or does it swivel?

A. Here are some photos and a dimensioned diagram of the Lunabotics collection bin. The dimensions shown in inches are 0.10" greater than actual final due to plywood thickness, etc. The trough upper long edge facing the regolith is adjusted to be approximately 1 meter above the regolith horizontal surface and in plane with the side wall of the regolith containment box. The trough is then fixed in place and does not rotate.



Excavation Questions

Q. Concerning rule #29. The rule says no far reaching mechanism. What distance is considered far reaching?

A. Please refer to Rule # 24. The hardware may deploy beyond the 1.5 m x .75 m footprint after the start of the competition attempt, but may not exceed a 2 meter height. The excavation hardware may not pass beyond the confines of the outside wall of the Lunarena and the collector during the competition attempt to avoid potential interference with the surrounding tent.

Q. Is a 2 robot system (one to dig and one to dump) allowed for the competition? If we can use a 2 robot system is there any regulations concerning that?

A. A two robot system is allowed but the total mass and starting dimensions must still meet the rules. The Lunabot SYSTEM must comply with the volumetric dimensions given in the rules. It doesn't matter how many parts the Lunabot system has – they must all fit inside the volume given in the rules at the same time.

Q. Can we use composite materials, (carbon fiber in particular). Our team is aware of the issues of using composite materials in the space environment (UV radiation degradation).

A. Composite materials may be used and do not have to be space qualified.

Q. Are brushless motors required?

A. Brushless motors are not required. You may use any motor that is suitable for your Lunabot. Since budgets are limited, the competition rules are intended to require Lunabots to show lunar plausible system functionality but the components do not have to be traceable to a space qualified component version.

Q. Can we use rubber and plastics on the excavator?

A. Reference Rule: 26 Components (i.e. electronic and mechanical) are not required to be space qualified for the lunar vacuum, electromagnetic, and thermal environments. You may use rubber parts, but you may not use rubber pneumatic tires, since it is unlikely we will use pneumatic tires in a lunar mission. Yes, you may use plastics.

Q. Can hydraulics or pneumatics be used on the excavator?

A. No, hydraulics and pneumatics cannot be used. They are not a good solution for the moon. The problem with hydraulics is not the G force. It is the thermal environment. Most hydraulic fluids will freeze in the shade and boil in the sunlight unless very well protected. Hydraulics also have a tendency to leak and require a lot of maintenance. Therefore, we do not anticipate the use of hydraulics on the moon.

Q. Can on board computers (the computer on board the excavating hardware/robot) be actively cooled (ie. have a fan running). I realize that this is a component, and is not required to be qualified for lunar environments, but the act of cooling is also a fundamental physical process.

A. It is reasonable to allow actively fan cooled electronics. This is part of not having to be space qualified.

Q. We are looking at expanding our wheelbase for additional stability upon startup. The wheels are not intended to be retractable again. Is this permissible?

A. Yes, that is acceptable. Reference Rule # 24.

Q. I see the rules mentioning "ramming" the walls, but we are considering a) backing up to the wall in front of the hopper, touching the wall, and b) having a small switch sensor springwire that may brush on a wall as a collision avoidance sensor. Is this allowed?

A. Touching the wall is acceptable. Ramming into the walls and using the wall as support or to scoop up against is not allowed.

Q. Are Hall Effect sensors which use magnets that might attract lunar dust allowed? Are proximity detectors, especially capacitive sensors, that don't use magnets allowed?

A. Proximity detectors and/or Hall Effect sensors are allowed. Please proceed at your own risk since the lunar regolith simulant is very dusty.

Q. Our lunabot may have a "shovel" or ramp in front of a belt system. We want to know if we are required to raise this ramp when going over the obstacle course (on the way to collection zone). If we do not raise it, we expect the ramp to accumulate some of the soil prior to getting to the collection area. When we turn on the belt system this soil will end up in our hopper. We basically do not want to get disqualified for collecting in the wrong area. The amount of soil is in the grams range not kilos.

A. Please reference Rule 6. Therefore, if you excavate any regolith simulant in the obstacle zone you will be risking disqualification.

Q. Concerning the emergency stop push button, is it acceptable to modify a 4 cm push button, to have a 5 cm button diameter?

A. The red push button must be utilized as stated in the rules. It must be highly reliable and instantaneous. For these reasons an unmodified "Commercial Off-The-Shelf" (COTS) red button is required.

Q. Is a 55 mm in diameter red button that maintains contact when depressed and runs a 3 amp normally closed control signal to a mechanical relay that will disconnect 200 amps acceptable?

A. Yes – it's fine as long as the relay stays open to disable the robot.

Q. Does the e-stop have to itself cut all power, or can it cut power to a relay which in turn cuts all power? (We are concerned with the current rating of the e-stop itself.)

Q. We have multiple power sources in our robot and are going to use a relay (actuated by our E-Stop switch) in line with each battery, which would break each circuit when the E-Stop switch is pressed. Is this acceptable, or must the actual battery leads run through the E-Stop switch?

A. The reason for this rule is to completely safe the Lunabot in the event of a fire or other mishap. The button should disconnect the batteries from all controllers (high current, forklift type button) and it should isolate the batteries from the rest of the active sub-systems as well.

Q. How do we obtain the IP addresses?

A. The rules state that teams bring their own Wi-Fi equipment which means you set your own IP address. NASA will provide a network cable in the Lunarena that runs to a network switch in the control room.

Q. Are we allowed to use 2 Wi-Fi channels, with one channel for the camera and the other channel for the lunabot motors?

A. No, you are not allowed to use two separate channels. Rule 23.A.2 explicitly states that teams cannot use multiple channels for data transmission.

Q. Could you please tell me what this wireless link is supposed to be? Do we have the capability to use Wi-Fi connectivity, router or Bluetooth?

A. Yes, you will need to bring your own router. NASA will provide an elevated network drop (Female RJ-45 Ethernet jack) in the Lunarena that extends to the control room, where we will have a network switch for the teams to plug in their laptop.

Q. In the Lunarena is the drop down Ethernet wire for each team directly connected back to the control room individually; meaning there are many cables going back to the control room or does it enter the NASA Intranet network and then go back to the control room as only one cable?

A. Yes, the physical cable runs from the Lunarena tent to the control room. There is no connectivity to the NASA network. A switch will be provided in the control room to allow multiple computers to be attached.

Q. Could you please tell me the location or the distance at which the Mission Control Room will be since accordingly the mode of communication between the lunabot and the controller can be decided?

A. The distance from the Lunarena to the control room will be around 150 – 200 feet.

Q. According to the rule on bandwidth, considering points a and c, does that mean we have to have a peak limit of 5 mbps, since the point (a) is contradictory to point (c)?

A. In regard to Bandwidth constraints, there is no peak bandwidth limit. Your average bandwidth must not be more than 5 megabits per second.

Q. Will we be able to recharge the batteries? What kind of access will there be to the excavator?

A. Yes, you will be able to recharge your batteries during the practice days and the competition days. Each team's competition attempt will be determined by random drawing. The lunabots will be quarantined during the competition. However, you will be able to re-install your battery before you compete with the inspection judge observing. You will have 10 minutes to put your robot in the sandbox before the 15 minute timed competition attempt begins.

Q. In case of a tie or runoff, will we be able to recharge or replace our batteries before the second event?

A. Yes, you may recharge your batteries after your first competition attempt. The battery charging station will be outside your Lunapit area.

Q. Are SLA batteries (sealed-lead acid batteries) approved for use in the robot?

A. Yes an SLA battery is acceptable.

Q. Are Nickel Metal Hydride (NiMH) batteries allowed, even with a sealed liquid electrolyte? These are used in electric and hybrid vehicles (Prius etc.) and have roughly the same operating temperature range as the Sealed Lead-Acid (SLA) batteries already approved.

A. Yes, NiMH batteries are allowed.

Q. What is the game play "Traversal Direction" in rule #6?

A. The "traversal direction" in Rule #6 refers to the direction the excavator will be facing at the beginning of the competition attempt. The front or forward face will be based on the reference point on the excavator. Please note in the definitions: "Reference point" will indicate the forward direction of the excavator.

Reference point – A fixed location on the excavation hardware which will serve to verify the starting location and traversal of the excavation hardware within the sandbox. An arrow on the reference point must mark the forward direction of the excavator in the starting position configuration. The judges will use this reference point and arrow to orient the excavator in the randomly selected direction and position.

Q. Could you please tell me what the dimensions will be in the Front View and Side View of the robot, since we are a bit confused about how the dimensions would turn out as according to my personal understanding, I realize that the wheel side (side view) will be less in size as compared to the front side of the robot.

A. The team can let the judge know the orientation of the excavator. You may reference Rule #24, specifically, the team must declare the orientation of length and width to the inspection judge.

Q. Are we allowed to use air-filled tires? Are we allowed to use foam-filled tires?

A. No, you are not allowed to use air-filled tires. Since foam filled tires are not likely to work in a vacuum, you should not use foam-filled tires unless you can make the case for foam working in a vacuum.

Q. Are we allowed to use honeycomb structures?

A. Yes, you are allowed to use honeycomb structures as long as they are strong enough to be safe.

Q. Are we allowed to gather the simulant into a container and then deposit the entire container (with the simulant inside) into the collection bin? (ex. Closed Bag)

A. The simulant must be deposited in the bin in its raw state. i.e. the container may not be deposited inside the collection bin, only the regolith simulant. Depositing a container in the bin will result in disqualification of the team.

Q. What will be the lighting conditions?

A. Lighting will be by artificial lamps inside a tent structure. Assume daylight conditions.

Q. What will be the atmosphere in the competition zone?

A. The atmosphere will be an air conditioned tent without significant air currents, at approximately 77 F.

Non-Excavation Questions

- Q. Concerning rule #32, it says we must submit a video showing the operation of the hardware. We have searched and cannot find when that is to be submitted by. Is there a deadline date for the video or is it used during the competition?**
- A. The video for Rule #32 must be submitted by May 3, 2011. The documentation for Rule #31 must be submitted by May 3, 2011 on the team form with the "team code" previously sent.
- Q. We would like to know if there is an average cost that last year's teams spent on their lunabot.**
- A. Estimates vary between \$10,000 - \$20,000 for materials, testing, roundtrip shipping and travel.
- Q. Concerning the slide presentation, do you have any more specifications as to the expected contents of the presentation than are listed on the website?**
- A. We have not given any additional guidance other than the rubric on-line.
- Q. How long should the slide presentation be? Are there any time restrictions?**
- A. There is no established maximum or minimum time on the slide presentation. It only needs to address the elements in the rubric. Teams may be allowed to briefly present their presentation at the competition for Team Spirit points if time allows.
- Q. Are the Systems Engineering Paper and the document in Rule 31 the same thing?**
- A. No, they are not the same thing. The Systems Engineering Paper is an extensive paper due on April 18, while the document in Rule 31 is brief documentation containing a description of the excavation hardware, its operation, potential safety hazards, a diagram, and basic parts list due on May 3, 2011. To clarify, although the Systems Engineering Paper may contain what is required in Rule 31 below, it should mainly address the systems engineering approach that your team took to design and build your robot. Refer to the Rules and Rubrics document at www.nasa.gov/lunabotics.
- Q. Concerning the Lunabotics Systems Engineering Paper, is the 10-15 page limit a requirement or a limitation. If we go over the limitation are we going to be penalized or disqualified?**
- A. The 10-15 page limit is a limitation. You may add things in the Appendix but the actual paper must be no more than 15 pages not counting cover page and sources. Refer to Auburn University's winning 2010 Lunabotics Systems Engineering Paper sent via e-mail to all the teams on March 21, 2011. The NASA Systems Engineering Handbook is available at: <http://education.ksc.nasa.gov/esmdspacegrant/LunarRegolithExcavatorCourse/Site%20Documents/NASA%20SP-2007-6105.pdf>.
- Q. With respect to the "Risk Assessment" portion of the Systems Engineering paper, are you looking for risks associated with power failure/shorts, mechanical design failures, communication failure, other topics, or all of the above?**
- A. The risk assessment portion of the paper should address sub-system risks and integrated system risks. The purpose of the risk assessment is to understand the likelihood and the related consequence of a potential failure. The combined values provide a quantification of risk levels. The risk items are then addressed in order of priority with a risk mitigation strategy. In this way all the risks can be addressed and eliminated to lead to the highest chance of mission success.
- Q. While looking over the Team Information Form, I noticed that our Systems Engineering Paper, etc gets uploaded on that form as well. Since there is only one "submit" button, I wanted to make sure it is ok that I submit other information before the paper, and won't have any issues not submitting everything at once.**
- A. Yes, that is correct. You can submit a new form for each due date or however you like. Nothing is deleted or replaced in your record.

Q. We are modifying an old robot of ours for this competition, and we utilized it as an exhibit for young people at a NASA function. We have many photographs of the children interacting with our exhibit. Would this count as community outreach?

A. No, community outreach involves an educational activity your team plans and hosts in your local community for students or the public. You may be creative and have fun with it but it does need to be done locally as a part of this competition.

The rubric explains: All teams must participate in an educational outreach project. Outreach examples include actively participating in school career days, science fairs, technology fairs, extracurricular science or robotic clubs, or setting up exhibits in local science museums or a local library. Other ideas include organizing a program with a Boys and Girls Club, Girl Scouts, Boy Scouts, museum, etc. Teams are encouraged to have fun with the outreach project and share knowledge of science, robotics, and engineering with the local community.

Q. Since the Outreach Project Report is due by April 18th and most of the outreach we do is later than that date, would it be possible to include our outreach from last year that was done after the submission of our paper last year?

A. No, the outreach report needs to be done on current year activities. If you have activities scheduled after the due date, you may mention your planned activities.

Q. Is there a maximum number of members per team?

A. NASA has not set an upper limit on team members per team. A team should have a sufficient number of members to successfully operate their lunabot.

Q. Should the faculty advisors appear in the team picture? And should the faculty advisors be part of the team biography?

A. Yes, we would like the whole team including the faculty advisors in the team picture, if possible, and included in the team biography.

Q. What information should be included in the team biography?

A. The team biography is for the competition program. Each team will have a page in the program. It should be something that each team would like everyone to know about them -- something that makes the team special or different.

Q. How can an international team collaborate with a US minority serving institution?

A. Teams may refer to [U.S. minority-serving institutions](#) for a list of all U.S. minority serving universities. It is your responsibility to make that connection if you so choose. You may post on the Lunabotics Facebook page in case the MSI students or faculty are members at www.facebook.com/lunabotics.

Q. Does the collaboration necessarily be with an MSI only or can it be with any other university/universities? And what kind of documents need to be submitted for the collaboration notification?

A. Please note in the Eligibility section of the website, teams may collaborate with other universities. Teams receive extra points if they collaborate with a minority serving institution in the United States.

Q. Our team consists of students from 3 different colleges but the registration is done in the name of lead university. Can all of us come under the banner of the lead university?

A. Yes, your team may collaborate with other universities under the lead university's banner. You will note the other universities on the team roster form. The link to the team roster form is on the team on-line form at <https://secure.spacegrant.org/esmdsg/forms/?form=lunabotics3>. All schools will be recognized on the plaques, certificates, and program.

Q. How and what do we need to provide you for the collaboration notification?

A. Collaborations should be noted on the team roster and submitted on-line.

Q. The college I am taking classes with will not be entering the competition. If, my former university approves, would NASA allow me to work with my previous college on this competition?

A. That is not a problem as long as your former university is okay with it.

Q. About collaborations, we registered in January and filled in the MSI we are working with. Is there anything else separate we have to fill out or was the registration part enough?

A. You will need to note the collaboration on the team roster form that is embedded in the team form at <https://secure.spacegrant.org/esmdsg/forms/?form=lunabotics3>. Additionally, the team members will need to complete their own participation forms, upload transcripts to verify their school affiliation and major, and upload the media release forms.

Q. Do you approve these two majors: Mining Engineering and Geological Engineering?

A. Yes, Mining Engineering and Geological Engineering are acceptable STEM majors and are approved for extra points. NASA will verify the major on the transcript for each team member to award these extra points.

Q. What is major in the form is it the specialization we are doing in engineering?

A. Yes, the student's major is their specialization, like Mechanical Engineering, Electrical Engineering, Physics, etc. There is a list of acceptable majors in the Rules and Rubrics document on the website: http://www.nasa.gov/pdf/390619main_LMC%20Rules%202011.pdf. If you have a team member with a major that is not on the list, you may request that it be added by sending Susan Sawyer an e-mail at Susan.G.Sawyer@nasa.gov. The transcripts will be used to verify the students' majors and school affiliation.

Q. Do the on-line forms have to be completed for each team member even if they are not coming to the competition?

A. Yes, all team members must complete an on-line student participation form including the transcript and media release. The transcript is proof that all team members are students. The media release covers the team photo being used in the competition program. Additionally, all team members will receive a certificate of participation.

Q. The students and faculty advisors complete their own individual forms and no code is needed for those, correct?

A. Yes, that is correct. Each individual student team member and faculty advisor needs to complete and submit his/her own individual form by March 7, 2011. The Team Lead is responsible for the Team Information Form and the code you received is for that.

Q. Do the forms and transcripts need to be provided for team members that will not be present at the competition?

A. Yes, we need the forms and transcripts for all members on the team, even if they are not coming. The reasons are:

- Points are awarded for each different STEM discipline represented on a team.
- Verification that all team members are college students.
- Collection of media release for all team members for pictures and film that may be provided by the team.

Q. I'd like to just have a clarification on what you mean by Media Release? Do we have to do a press release?

A. Because NASA will have videographers and photographers at the event, NASA requires a media release to be able to publish any pictures in reports, the event program, video, brochures, etc. The form is embedded in the participation on-line form. No, you do not have to do a press release.

Q. Please let me know if it is possible to complete the Media consent form online, or do we need to fill a printed copy and then upload the scanned version.

A. You will need to print and upload the scanned copy with your printed name, signature and date.

Q. What is the maximum number of points a team can earn? How many do we need to place in first, second, and third place?

A. The maximum number of points that a team can accumulate is 125. That would mean earning the maximum points in every category. The accumulation of the most points determines the winner of the Joe Kosmo Award of Excellence. First, second, and third place in the mining category is determined by the amount of BP-1 collected.

Travel & Competition

Q. Will there would be internet access at the competition?

A. No, we will not have wireless connectivity at the venue.

Q. Will you provide the accommodation or we have to arrange it?

A. Teams have to make your own accommodations. We have posted the General Information on the website at: [Lunabotics General Information \(PDF\)](#). There is a link to hotels in the area and directions from the airport in that document.

Q. When will the hotel information be available?

A. Each team may choose where they would like to stay during the competition. The Space Coast Office of Tourism offers a website for lodging accommodations, dining and entertainment. Please visit <http://www.space-coast.com>. In order to make hotel arrangements through another site, look for lodging in Titusville, Merritt Island, Cocoa, or Cocoa Beach, Florida. The Best Western in Cocoa Beach has offered a special rate and they are planning to host a beach party for the teams.

Q. Will any transportation be provided from the hotel to the event?

A. No, teams are responsible for arranging their own transportation.

Q. Will there be any meals provided during the competition days?

A. There will be food available for purchase during the practice days and the competition days. Dinner will be provided at the Awards Ceremony.

Q. How will the competition will be different this year compared to last year? I know there are a lot more teams signed up this year and last year we were already pressed for time and space because of all the teams. Will there be more than one Lunarena?

A. We have moved the competition to the KSC Visitor Complex so we will have much more room. Each team will have a Lunapit area of approximately 10' x 10' in which to work on their lunabot. We will still only have one Lunarena. Teams will only be able to compete one time unless we have a tie. We will have three competition days to accommodate the additional teams. The biggest difference this year will be with communications. Be sure to review Rule #23 in the Rules and Rubrics on the competition website: www.nasa.gov/lunabotics.

Q. Do all official team members need to be present for the competition?

A. No, all team members do not have to be present, just enough to effectively operate your Lunabot.

Q. We have people who are not university students that are interested in being officially a part of the team. Are we allowed to list them as official team members?

A. No, they may not be official members of your team. You may have corporate consultants or advisors as part of a team sponsorship.

Q. The schedule lists Monday, May 23, 2011 as the check-in and unload date. We are trying to finalize travel and it looks like we'll have some students flying down to save time away from their internships and we've been trying to figure out if it is critical that all students be there on that Monday to check-in or is it OK that some come in late that day or the next?

A. No, all team members do not have to be here for the check-in day on Monday. We will have communications checks on Monday and Tuesday only so whoever will be doing communications will need to come for this. Practice will be on a first-come, first-serve as teams are ready.

- Q. Other team members have contributed to our robot so the four people in control room and the field aren't the only ones accepting any awards won, right? If a team wins and say they have 6 people total they will all get credit where credit is due, be in pictures, get awards etc... We were internally discussing this matter and we were sort of conflicted?**
- A. Yes, the whole team on the roster will get credit.

Shipping

- Q. May the universities ship their lunabots directly to Kennedy Space Center?**
- A. You may ship the robots to arrive no earlier than May 16. They will be held in a safe area.
- Q. What is the address of the department which will take receipt of the lunabot if we choose to ship it?**
- A. The shipping address is:
Kennedy Space Center Visitor Complex
Lunabotics Mining Competition
Mail Code: DNPS
Kennedy Space Center, FL 32899
- Q. Do we need to arrange for the lunabot to be shipped back home?**
- A. Yes, return shipping arrangements must be made prior to the competition.